



A description of the south Florida nighttime recreational tournament fishery for swordfish, *Xiphias gladius*

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ABSTRACT.—Swordfish (*Xiphias gladius* Linnaeus, 1758) are increasingly sought after by recreational anglers globally. The Florida Straits in particular is an important breeding and nursery area for North Atlantic swordfish, as well as the historical fishing grounds for both recreational and commercial swordfish fisheries. The traditional nighttime recreational fishery for swordfish in southeastern Florida is categorized into two periods. The first period started in 1977 and consists of the first tournaments in the area to specifically target swordfish. Despite high initial catches, low catch numbers resulted in the conclusion of the swordfish tournament fishery in 1983. The second period of the fishery started in 2000 and continues to the present (2015). Data were collected from a total of 118 swordfish tournaments (17 historical, 101 modern). For comparison, data were also gathered from 66 billfish tournaments that occurred during the modern period. The tournaments studied occurred on the southeast coast of Florida from Stuart to Key West. Although participation correlated to the number of catches, catch per hour (CPH) remains on a slow decrease over time. The entry fees for modern period swordfish tournaments range from \$200 to \$1000, while those for the more exclusive billfish tournaments were tenfold higher. The average weight of landed swordfish remained roughly the same throughout the two time periods, despite the oscillation of catch numbers, which may be due to the minimum length restrictions implemented in the modern period tournaments. Analysis of the nighttime tournament fishery, especially across two distinct time periods, provides new insight into the swordfish stock.

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The swordfish, *Xiphias gladius* Linnaeus, 1758, is one of approximately 30 pelagic fishes considered to be highly migratory. Although the species was historically considered a billfish, *X. gladius* is a monospecific genus and family apart from the istiophorid species like sailfish, *Istiophorus platypterus* (Shaw, 1792), and blue marlin, *Makaira nigricans* Lacépède, 1802 (Collette et al. 2006). Swordfish are one of the most widely distributed pelagic fishes, with a circumglobal distribution in tropical

and temperate waters ranging from 45°N–60°N to 45°S–60°S (Sakagawa and Bell 1980, Ward and Elscot 2000).

Although swordfish is genetically a single species worldwide (see Palko et al. 1981), there are eight stocks defined for management purposes: four in the Pacific Ocean, two in the Atlantic Ocean, and one each in the Indian Ocean and Mediterranean Sea. The International Commission for the Conservation of Atlantic Tunas (ICCAT) develops consensus recommendations for the management of swordfish stocks by its 50 member countries in the North and South Atlantic ocean and the Mediterranean Sea. The Atlantic Highly Migratory Species (HMS) Management Division of the US National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS) domestically manages swordfish through the legislative authority of several statutes, including the Atlantic Tunas Convention Act (16 U.S.C. 971-971k) and the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1801). Management of HMS fisheries by NMFS is also conducted by applying additional domestic regulations beyond those recommended by ICCAT, including mandatory vessel permits, catch reporting, and gear restrictions.

Swordfish and other pelagic fishes congregate in the Florida Straits, an area characterized by a narrow continental shelf that drops off relatively close to the southeastern coast of Florida (Berkeley and Houde 1981, Prince et al. 2007). The high number of canyons and seamounts cause a relatively large amount of current-driven upwelling from the local Florida current, thereby enhancing biological productivity (Taylor and Murphy 1992, Fiechter and Mooers 2003). In particular, the area has long been known as favorable to swordfish spawning and juvenile maturity (Arata 1954, Markle 1974, Grall et al. 1983). Other areas along the eastern coast of the United States and within the Gulf of Mexico have a much broader continental shelf, forcing the species farther offshore (Knauss 1996, Sedberry and Loefer 2001, Fiechter and Mooers 2003).

FISHERY HISTORY.—Recreational fishing, especially in Atlantic waters off south Florida, is a popular outdoor activity, attracting large numbers of anglers and resulting in high levels of effort (Cowx 2002, Westera et al. 2003). Swordfish, which are normally found at significant depth during the day, are found foraging in near-surface waters at night, when recreational anglers target them with drift fishing techniques. Although recreational targeting of western North Atlantic swordfish began in the 1920s (see Crandall 1926, Gray 1927), the swordfish recreational fishery in the Florida Straits began in 1976 (Dunaway 1976). The first swordfish tournament in southeast Florida, held in Miami in 1977 (Berkeley and Stroud 1989), was the first night tournament to focus on drift fishing with chemical lights as attractants. Drift fishing techniques also consumed less fuel than actively trolling, thereby minimizing trip costs. In that single Miami tournament during 1977, 60 fish were landed by the 27 participating boats (Berkeley et al., University of California Santa Barbara, unpubl data), and roughly 500 swordfish were recreationally caught throughout the remainder of that year (Beardsley and Stroud 1988). Interest and activity spread south to Key West and north to Fort Pierce (Anonymous 1977, Dunaway 1977). During the late 1970s through the early 1980s, both anglers and scientists considered swordfish to be the most common big game fish species in south Florida waters (Dunaway 1976, Stutz 1981).

During the mid-1970s, the US domestic commercial sector began to change the primary fishing gear type from harpoon to pelagic longline, thus improving their

catch rates and total landings (Berkeley and Stroud 1989, Watson and Kerstetter 2006). The domestic pelagic longline fleet also began targeting swordfish in the Florida Straits at approximately the same time that the recreational fishery began off the southeast Florida coast (Conser et al. 1986). Some of these new participants were seasonal, with New England–based vessels traveling to fishing grounds in the Windward Passage and other southern locations, including the Florida Straits (Hoey and Bertolino 1988, Hoey and Casey 1988, Gibson 1998). As early as the late 1970s, swordfish anglers were voicing concern about declining catch rates and individual fish sizes (Berkeley et al., University of California Santa Barbara, unpubl data), and by the 1980s, many anglers were publicly complaining that little control was put on the commercial longline fleets targeting swordfish in the Straits of Florida (Lech 1985, 1987).

Conflicts between recreational and pelagic longline vessels, as well as declining catch rates during tournaments, are thought to have brought about the demise of the recreational swordfish tournament fishery in 1983 (Berkeley and Stroud 1989), the last year in which a south Florida swordfish tournament was held until the modern period (2000–2015). Starting again in 2000 with the Sword Lords event based in Fort Lauderdale, the nighttime tournament fishery experienced a relatively short resurgence, especially during the early 2000s. Although the use of pelagic longline gear was prohibited by NOAA in 2001 within the Florida Straits (NOAA 2006), a “buoy gear” fishery commercially targeting swordfish subsequently developed in the early 2000s (Kerstetter and Bayse 2009; T Palmer, F/V BLUE BARON, pers comm). Swordfish buoy gear is usually fished at night and consists of one or more floats supporting a short vertical mainline with no more than two hooks attached (NOAA 2015).

USE OF FISHING TOURNAMENTS FOR DATA COLLECTION.—Under present recreational fisheries regulations, NMFS requires that all anglers who catch and land swordfish report their landings online or by phone within 24 hrs; however, some anglers do not report. The limited number of enforcement agents available to monitor landings sites (e.g., marinas and boat ramps) combined with the common practice by anglers to land their fish at private docks has made enforcement of this regulation difficult (D Kerstetter, pers obs). Since 2001, NMFS has also required tournament directors to register all tournaments targeting swordfish, billfishes, sharks, or tunas at least 4 wks prior to the start of a tournament, as well as to report information (e.g., total number of boats participating, hours fished, number of fish kept, number of fish released) when the tournament is complete, if the tournament is selected for reporting (NOAA 2006).

With the exception of Lerner (2009), little information is available on the economics of the recreational swordfish fishery or the swordfish-targeting tournaments in southeast Florida, although Levesque and Kerstetter (2007) described three tournaments collectively in 2002. Using a combination of historical and current data, the present study provides a more comprehensive analysis of the participation and catches in the two periods of the tournament fishery, as well as limited comparisons with the co-occurring recreational istiophorid billfish fishery.

MATERIALS AND METHODS

For the purposes of the present study, the fishery was divided into two periods: the “historical” period from 1977 to 1983, and the “current” period from 2000 to 2015 that followed the 17-yr hiatus in active swordfish-targeting tournaments. Although fishing club records have been used in other recreational fisheries to trace catch and landings trends (reviewed in Gartside et al. 1999), no equivalent swordfish club exists in southeast Florida that regularly and consistently compiled records of individual member catches. Charter (“for-hire”) vessels service this fishery; however, none do so exclusively, unlike istiophorid billfish fisheries (e.g., Ditton and Grimes 1995). Thus, the present study relied solely on recreational tournament records.

Tournament reports (e.g., Berkeley et al., University of California Santa Barbara, unpubl data) and hand-written datasheets from swordfish tournaments were obtained from the historical period (S Berkeley, University of California Santa Barbara, pers comm). Additional information on these historical period tournaments was also obtained from records at the EK Harry Library of Fishes at the International Game Fish Association (IGFA; Dania Beach, Florida). Information on swordfish tournaments from 2000 through 2015 has been collected from various tournaments in south Florida by researchers at Nova Southeastern University. Information not obtained by tournaments through observing or personal contacts within the fishery was collected through internet searches of fishing forums (e.g., <http://www.swordfishingcentral.com>), individual tournament websites, and popular sport fishing literature (e.g., monthly magazines such as *Florida Sportsman*, *Sport Fishing Magazine*, and *Saltwater Sportsman*). Supplemental data were obtained from the NMFS Recreational Billfish Survey, using data self-reported by swordfish tournament operators who were selected for reporting.

Information gathered on each tournament included: (1) fishing time (“lines in to lines out”), (2) entry fee, (3) total number of boats fishing (all tournaments used in this study charged entrance fees and recorded catches per boat, not per angler; most tournaments had a four-person limit per boat with few exceptions having up to six people for an additional fees), (4) total number of fish caught, and (5) total prize monies awarded. Although these five data points were sought after, it was found that not every tournament advertised them all.

Tournaments were compared using several metrics. Catch per hour (CPH) was calculated by:

$$CPH = (f/E) \times 100,$$

where f is total number of fish caught including those boated and released, and E is the gross fishing effort. Gross fishing effort was calculated by:

$$E = b \times ([lines\ out - lines\ in] \times d)$$

where b is the number of boats participating in the tournament, $lines\ out$ is the predetermined time to stop fishing, $lines\ in$ is the predetermined time to begin fishing, and d is the number of fishing days in the tournament.

Traditionally, catch per unit effort (CPUE) quantifies the catch relative to the total amount of time fished and the number of participants. Here, we used catch per

hour (*CPH*) as the CPUE metric, as each tournament had different but delineated allowable hours of fishing. A combined baseline *CPH* was developed by obtaining an average *CPH* based on the two fishing periods. This baseline was used to test *CPH* between each period of fishing, as well as throughout the two periods. Total prize monies awarded per year and averaged prize monies awarded per year were compared between and among swordfish and istiophorid billfish tournaments through one-way analyses of variance (ANOVAs). Swordfish and istiophorid billfish tournament entrance fees were standardized to 2009 values (Williamson 2016) and the difference in means compared with a two-sample *t*-test.

Individual swordfish weights were gathered for fish landed during each tournament. Weights are typically recorded as pounds in United States recreational fishing tournaments; however, all weights were converted to kilograms for comparison purposes. Lengths were not used, as tournament officials generally did not measure length during tournaments, especially within the modern period.

Data from istiophorid billfish tournaments from the modern period were also collected for comparison purposes. The same five data points for each tournament were gathered in a similar fashion to that of the swordfish data from the modern period, although most information was collected from tournament websites and popular sport fishing literature rather than personal contacts or direct observations.

RESULTS

In total, data were gathered from 118 swordfish tournaments; 17 from the historical period and 101 from the modern period (Table 1). Any 6-mo “derby” tournaments (e.g., the Southeast Swordfish Club Six Month Tournament from 2004 to 2009) were excluded from subsequent analyses, as were any daytime tournaments (e.g., the Full Moon Adventures Hydroglow Winter Swordfest Daytime Tournament from 2005 to 2009). The original historical period tournament report and datasheet documents have been deposited with the EK Harry Library of Fishes, and the one formal report from an early-period tournament is available upon request from DWK (Berkeley et al. unpubl data). Data were also collected from a total of 66 istiophorid billfish tournaments from the modern period. Of these tournaments, 67% specifically targeted sailfish, while the remaining either targeted blue marlin exclusively or targeted a combination of istiophorid billfish species.

ANGLER PARTICIPATION.—Average vessel participation decreased sharply through the historical period ($R^2 = 0.449$). Participation in the modern period also showed a similar, albeit slower, overall decrease ($R^2 = 0.358$) (Fig. 1); however, neither decrease was significant ($P = 0.0995$ and $P = 0.6086$, respectively). Throughout both periods, vessel participation per year oscillated between high and low numbers with the highest in 2007 (653 vessels over the course of the year). From 2002 to 2007, eight tournaments each had more than 70 vessels participating; however, from 2008 to 2015, the highest single-night vessel participation for all 27 tournaments studied was 96 vessels in the 2007 Hydroglow Swordfish Slam event.

ENTRANCE FEES.—Throughout the modern period, average swordfish tournament entrance fees were between \$200 and \$1000 per team. The highest entrance fee during the modern period was \$1000 per team for the Miami Swordfish Tournament and the Islamorada Swordfish Tournament, both run by the same tournament organizers.

Table 1. Sources of data for description of southeast Florida swordfish tournaments, 1977–1982 and 2000–2015. Additional information on the 1978 Miami Swordfish Tournament is available upon request from one of us (DWK).

Tournament	Years
Adopt A Swordfish Tournament	2005
Burnt Out Sunburned Swordfish Tournament/Outing	2007–2015
Dark Side I	2002
Dark Side of the Moon I	2003–2006
Dark Side II	2002, 2003
Dark Side III	2004
Duck Key Swordfish Tournament	1977, 1978
Dusk to Dawn Swordfish Tournament	2005–2007
The Finest Kind Swordfish Outing and Tournament	2003–2008
Fort Lauderdale Swordfish Tournament	1977–1983, 2007
Fort Lauderdale International Invitational Swordfish Tournament	1978–1979
Fort Lauderdale City Tournament	1979
Castaways Summer Broadbill Classic	2007
Castaways Fall Broadbill Classic	2007
Grand Slam Broadbill Classic	2005–2008
Grand Slam Hydroglow Broadbill Classic	2005–2007
Haulover Swordfish Tournament	2007
HydroGlow Summer Swordfish Slam	2005–2008
Full Moon Adventures Summer Swordfish Slam	2009
Islamorada Swordfish Tournament	2004–2010
Jurassic Drift	2007
Lauderdale Yacht Club Swordfight	2003, 2005
Miami Swordfish Tournament	1977–1980, 2003–2013
S.A.I.L. Fishing Club Swordfish Tournament	2005, 2006
Southeast Swordfish Club Fall Tournament	2004–2009
Southernmost Swordfish Tournament / Key West Tournament	2003–2008
Stuart Release Tournament	1978
Sword Lords	2000–2009
Sword Lords II	2002

In contrast, the average entrance fees for billfish tournaments were between \$2000 and \$5000 per team. The highest entrance fee values rose sharply from \$4580 in 2006 to \$9210 in 2007, and then leveled at roughly \$7500 from 2008 onward. The difference in means between the entrance fees of swordfish and billfish tournaments throughout the modern period was significant (t -test: $t = 1.66$, $P < 0.0001$), with billfish tournaments charging roughly tenfold those targeting swordfish.

PRIZE MONIES.—Likewise, Figure 2 shows that the average prize monies awarded in billfish tournaments during the modern period (range: \$82,333–\$232,982) were significantly larger than those of swordfish tournaments in that period (one-way ANOVA: $F = 26.69$, $P < 0.001$). Average billfish prize amounts were the highest in 2008 (\$232,982), although more tournaments took place in 2009 (11 in 2008 vs 14 in 2009). Swordfish prize monies remained relatively consistent over the current period, with the highest average amount (\$27,802) in 2007. Prize monies were lowest in

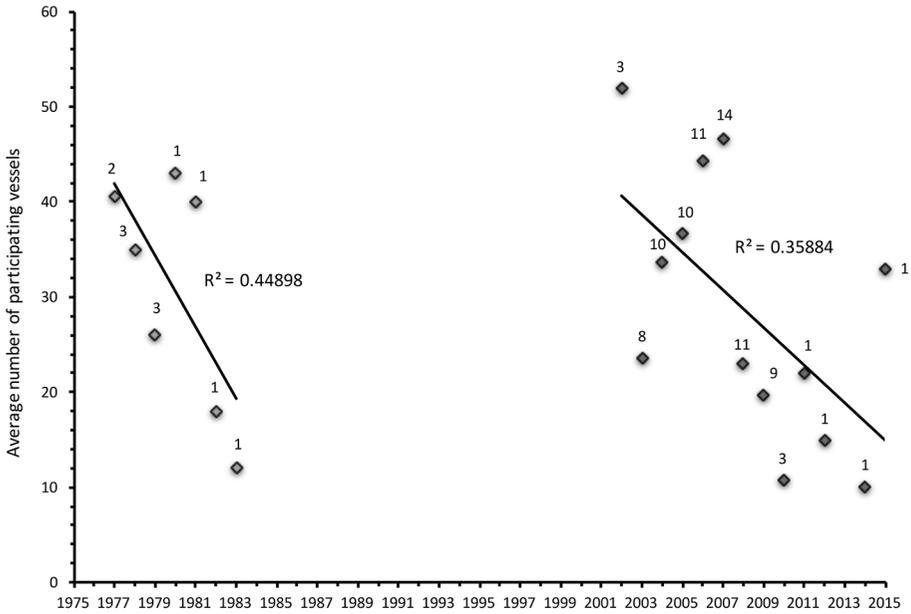


Figure 1. Average vessel participation per year for swordfish tournament catches in southeast Florida, 1977–1983 and 2002–2015. Data labels indicate the number of tournaments included for analysis during each year. The decline was not significant for either the historical or modern period ($P = 0.0995$ and 0.6086 , respectively).

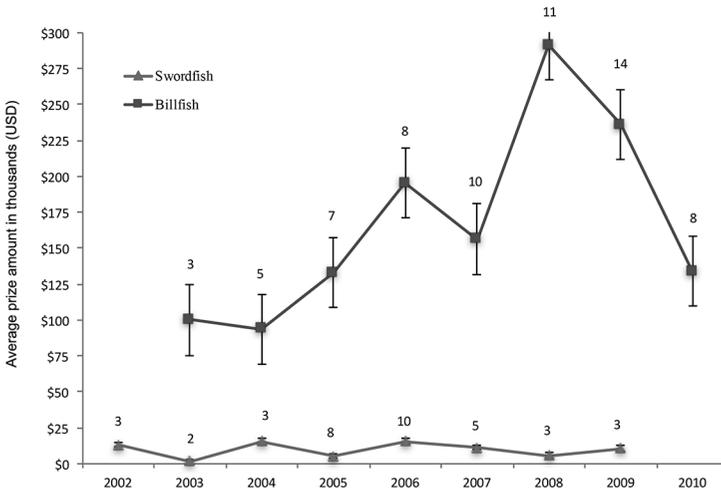


Figure 2. Comparison of total prize monies for tournament awards for swordfish and istiophorid billfish tournaments in southeast Florida, 2002–2010. Values are standardized to year 2009. Data labels show the number of individual tournaments with prize values. The time-series was discontinued for comparative purposes between the two tournament fisheries after 2010 when swordfish tournaments all went to payouts as a percentage of total entry fee revenues rather than set prize amounts.

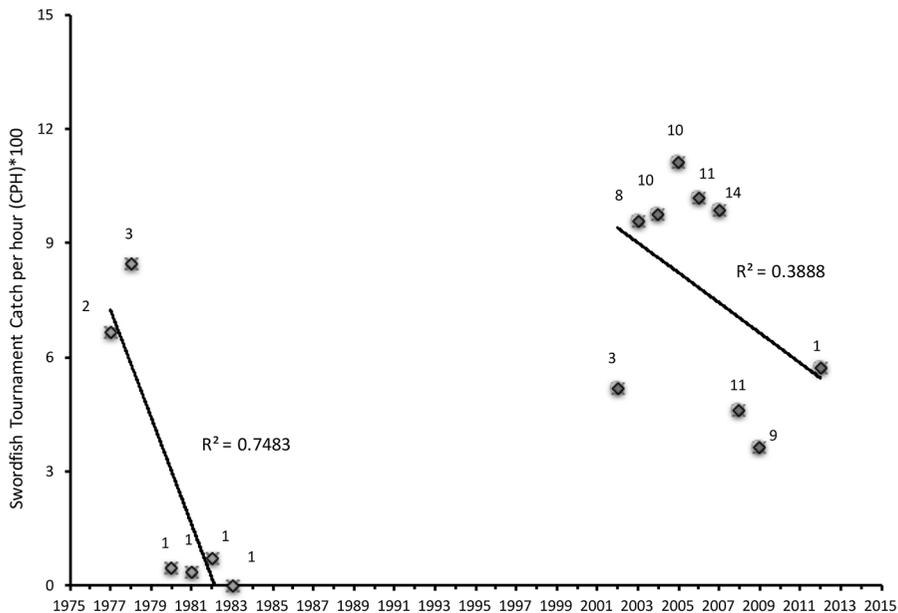


Figure 3. Averaged swordfish catch per hour (CPH) over time for tournament catches in southeast Florida, 1977–1983 and 2002–2012. Data labels indicate the number of tournaments included for analysis during each respective year. The decline was significant ($P = 0.0119$) for the historical period, but not so ($P = 0.0985$) for the modern period.

2003 ($\bar{x} = \$82,333$; $n = 3$) for billfish tournaments. The lowest prize money amount awarded for the swordfish tournaments was also in 2003 ($\bar{x} = \$9625$; $n = 2$).

CATCH PER HOUR.—We obtained sufficient data to allow the calculation *CPH* from 66 swordfish tournaments; 11 from the historical period and 55 from the current period. We found a significant decrease in mean *CPH* values over time in the historical period ($P = 0.0119$, $R^2 = 0.7483$), while the modern period shows no significant decrease in *CPH* over time ($P > 0.583$; $R^2 = 0.3888$; Fig. 3).

CATCHES.—Tournament data recorded 3181 swordfish catches, 249 in the historical period and 2932 from the modern period (Table 2). Mean and total catches in 1977 were the same as in 2002 and the average values dropped nearly the same amount for the next year in both periods. Unlike the remainder of the historical period, mean catches in swordfish tournaments rose for the next 3 yrs in the modern period until they began decreasing again in 2007—the last year of high average participation numbers—and decreasing yet again in 2008 to the same levels as 1978. The total catches of swordfish through both the historical and modern periods match patterns with total vessel participation. The total and average catches of swordfish during the historical period decreased until no fish were caught in 1983. Catches in 2005 and 2006 were highest overall ($n = 722$ and 623, respectively).

LANDED WEIGHTS.—Individual weights were available for a total of 825 tournament-caught swordfish (historical period $n = 181$, modern period $n = 644$). Despite anecdotal views within the fishery of smaller fish, neither the historical period ($P > 0.245$) nor the modern period ($P > 0.965$) showed significant changes in individual

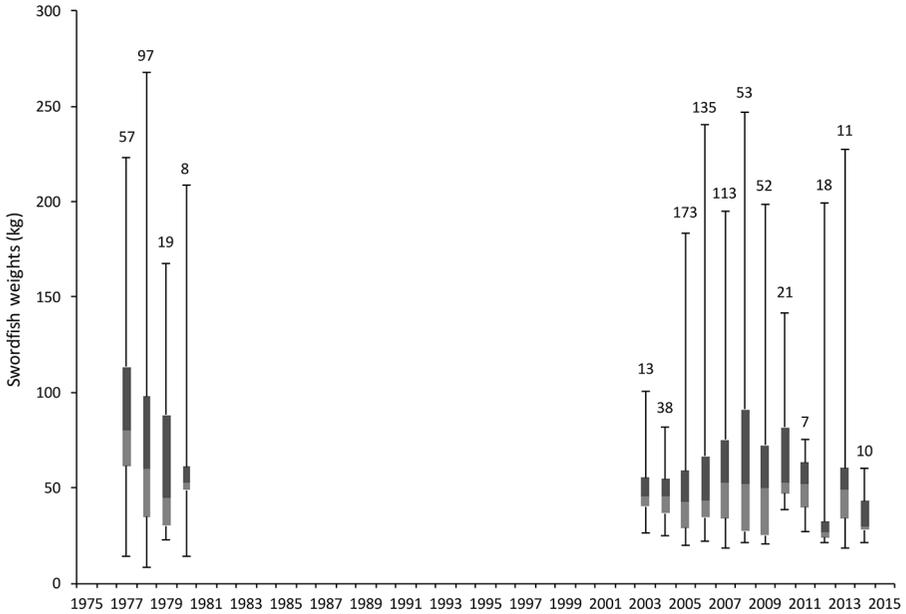


Figure 4. Box-and-whisker plots for swordfish weights (kg, converted from original pounds) by year for tournament catches in southeast Florida, 1977–1980 and 2003–2014. Plots show the minimum, 1st quartile, median, 3rd quartile, and maximum, and top labels show the number of individual swordfish with weight values included for analysis during each respective year. The mean weight for the historic period ($n = 181$) was 74.85 kg, while the mean weight for the modern period ($n = 644$) was 55.30 kg.

swordfish weights between years (Fig. 4). No swordfish weights for 1983 were used for the analyses, as no fish were caught in the tournaments during this last year of the historical period. The mean fish weight in 1977 was 87 kg, dropping down to 43.2 kg in 1981. Although no swordfish were caught during the one 1983 tournament with extant records, a contemporary report by Leech (1985) described swordfish weights in the fishery as averaging under 22.7 kg. Mean weights of fish remained relatively close to each other throughout both periods with unexplained dips in 2009, 2012, and 2015, including an outlier low mean weight of 122.7 kg in 2012.

DISCUSSION

The present study is the first description of the nighttime recreational swordfish tournament fishery in southeast Florida and provides new information about both the historical and modern fishing periods. Given that changes in techniques and gear will affect catchability coefficients, studies like this provide data useful as baseline knowledge for future stock assessments and subsequent management. The North Atlantic swordfish stock as a whole is now defined as “rebuilt” ($B_{MSY} > 1.0$; ICCAT 2015), and the data from the recreational tournament fishery from the Florida Straits show no significant decline in CPUE over the period of the current fishery.

It is difficult to separate the historical and modern periods of the Florida Straits recreational swordfish fishery from both the overall management history of the North Atlantic swordfish stock and the actions within the commercial fishery itself. The apparent stability in the modern recreational swordfish fishery is likely a

result from the combination of many management actions, including the closure of the Florida Straits to the US commercial pelagic longline fishery in February 2001 (described further in NOAA 2006) and the various management actions at the international level. Despite scientific studies (e.g., Kerstetter and Graves 2006), the fishery also continues to believe that the mandatory change to large, non-offset circle hooks in 2004 (NOAA 2006) reduced catches beyond the minimum economic threshold for many commercial vessels. Other changes in the interim period between the historical and modern recreational fishery periods include improvements in lightstick technology and a series of deployment requirements (e.g., the length of the individual leader must be a minimum of 110% of the length of the floatlines; NOAA 2006). It is not the purpose of our research to provide a comprehensive history of the fishery as a whole, as several other publications provide that information already, such as Gibson (1998) and NOAA (2006). Nonetheless, the data from the historical recreational fishery is suggestive of impacts of an influx of high levels of commercial fishing pressure. Thus, any management actions potentially increasing the current level of commercial fishing activity in the Florida Straits should be approached with caution.

Anglers participating in swordfish tournaments during the 1970s openly shared information with the researchers and were interested in the findings (S Berkeley, University of California Santa Barbara, pers comm). Management-directed surveys of the recreational HMS fisheries in the mid-1990s revealed some swordfish landings (tournament and non-tournament); however, so few interactions with the recreational fishery were recorded prior to and through the 1990s that they were not counted toward the US Atlantic swordfish quota until the implementation of the 1999 Fishery Management Plan (NOAA 1999). Current recreational fisheries surveys and landings reporting programs continue to be improved, providing valuable information not only to management, but also to researchers and the public (e.g., Venizelos 2003).

Unfortunately, we were unable to evaluate changes in technique and effective fishing effort. Most recreational anglers targeting swordfish have continued using J-style hooks, rather than the circle hooks now required of the commercial pelagic longline fleet and anglers participating in istiophorid billfish tournaments (D Kerstetter, pers obs). The use of chemical lightsticks at the onset of the modern fishery period, and electronic LED lights more recently, likely had an indeterminate effect on catch rates, as did higher quality monofilament line and electronic vessel navigational aids. As with many other recreational fisheries, improvements in vessel motors have enabled anglers to fish additional areas that may have only been marginally accessible in early tournaments, even if the tournament's "eligible waters" rules did not change. Fishery metrics, such as CPUE and landed weights, have value to management and stock assessment, but we encourage researchers to also document vessel and gear characteristics for potential future comparisons.

Similar to the contemporaneous Atlantic-wide swordfish fishery, the average landed weights of the historical period of the Florida Straits recreational fishery significantly decreased over time, although the average weights of the modern period remained relatively consistent, except for the very low average weights in 2012. The average weights also show more variation in the historical period than the modern. This may be the result of the size regulations enacted during the modern period, but could also reflect the limited available tournament data. The minimum and maximum weights reported from tournaments within the historical period are 8.73 and

267.62 kg, respectively, while the minimum and maximum weights of the modern period are 24.95 and 247.21 kg, respectively.

During the historical period, there were no size regulations on the recreational fishery. In contrast, the minimum legal retention size in the modern period is 15 kg (dressed weight). Although some tournaments no longer use a weight minimum, the majority have a minimum length limit of 154.5 cm (61 in) lower jaw fork length (LJFL), which is more restrictive than the legal limit of 119.3 cm (47 in) LJFL. Also, anglers are allowed to bring in one fish per person (up to four fish per boat) per trip by regulations of the modern period, in contrast to the historical period that had no retention limit.

The decline in vessel participation in the historical period may be a response to the decrease of swordfish being caught. While the initial vessel participation during the modern period was high among the first two tournaments (held in 2000 and 2001), it was low in 2003 and steadily climbed until 2008, when participation suddenly dropped. This decline may be due to lack of interest in recreationally targeting swordfish; however, there may also be a correlation with the United States' economic decline during 2007 and 2008, when some anglers simply could not afford to target swordfish, often citing the high cost of fuel as an impeding factor. Many anglers also complained in online forums that entry fees were too high when they had not been catching swordfish over the past few years; during the Miami Swordfish Tournament in 2011, for example, only one swordfish was caught and retained.

The highest average prize money amount (\$27,802) throughout the current period for swordfish tournaments occurred in 2007. Average prize money amounts for billfish increased each year until 2008 (\$232,982), then fell rapidly to \$144,169 in 2009, and again to \$102,712 in 2010. Throughout the modern period, billfish tournaments held higher purses than swordfish tournaments, which could be attributed to greater interest and resulting participation, higher entry fees, and more corporate sponsorship. Billfish are also primarily a "trophy" fish in US Atlantic waters, as they are not commercially landed nor sold legally within the United States (other than in Hawaii, which is under a different management regime; see WPRFMC 2009).

The average catch values were highest in 2001, the same year that pelagic longline vessels were no longer permitted to fish in those waters and the first year when advertised swordfish tournaments were being held again (the Sword Lord tournament in 2000 was initially conceived as a test-tournament to see if swordfish could be caught again; J Hald, Sword Lords tournaments director, pers comm). In the single tournament Sword Lords 2001, 70 swordfish were caught. Since 2001, the number of individual fish caught during swordfish tournaments declined to a mean of 38 fish in 2002 ($n = 3$ tournaments), and then fell again to a mean of 14.75 fish caught per tournament in 2003 ($n = 8$ tournaments) with a mean of 52 and 23.5 vessels per tournament, respectively. Per boat, a mean of 0.731 fish were caught in 2002 and 0.628 fish were caught in 2003. From here, the average catches increased again, but only to a high of 39 in 2005 and then very low catches in 2008 and 2009, 8.5 and 6.25, respectively. As of December 2015, the Burnt Out Sunburned Swordfish Tournament/Outing was the only nighttime swordfish tournament still operating on a regularly scheduled basis.

Similar to prize amounts, entrance fees are typically much higher for billfish tournaments than swordfish tournaments. The maximum and minimum entrance fee amounts for billfish tournaments changed yearly until 2008, when they remained

consistent through 2010. In 2004, the average entrance fee for billfish tournaments was over seven times as costly as that for swordfish, and in 2005, the year with the largest difference between fee amount, billfish tournament entrance fees were almost 10 times more expensive than swordfish tournaments. The difference dipped slightly in 2006, with billfish tournaments being 4.5 times higher, rose and dipped again in 2007 and 2008, respectively, and settled at 3.63 times higher than swordfish tournament entrance fees in 2009.

The final factor potentially affecting the nighttime recreational tournament fishery is the increasing dominance of a new gear type, colloquially called “deep-drop gear,” which uses an electric (or otherwise powered) reel to target swordfish during daylight hours. The use of an electric reel is prohibited by IGFA angling rules, which most tournaments generally follow (IGFA 2016); however, targeting swordfish during daylight hours is more amenable to the normal charter (“for-hire”) fleet schedules, as well as for the average recreational angler. The relatively low numbers of daytime swordfish-targeting tournaments in the modern period, as well as their complete absence during the historical period, precluded their inclusion here. A comprehensive examination of the deep-drop swordfish fishery is strongly recommended to capture area-specific trends in swordfish catches.

CONCLUSIONS

Although commercial and recreational fishery participants have different goals associated with their participation (Cooke and Cowx 2006), both components impact the underlying stock and thus should be monitored for management purposes. Historically, commercial fisheries have been relatively well monitored through various combinations of logbook reporting, fisheries observers, and ex-vessel landings reports by dealers. Recreational fisheries, especially those primarily catch-and-release, have been less documented. In the specific case of the southeast Florida recreational swordfish fishery, nighttime tournaments provided an opportunity to examine changes over time using a relatively consistent metric.

Our results highlighted main points of interest for tournament operators and recreational fisheries researchers. Contrary to popular thought, the average weights of swordfish remained relatively constant between the historical and modern periods, even though catch rates and absolute numbers of caught fish decreased in the later years of the present study. The vessel participation for the last years of the study were also among the lowest seen through both periods, as were the averaged *CPH* efforts. Despite evidence of a rebuilt, healthy North Atlantic swordfish stock, the decline in the number of tournaments over time is another indication of the perception of a reduced swordfish population and how that perception affects angler participation, even with advances in fishing technology.

An important next step is to look more closely at the tournaments and those individuals fishing them. The knowledge of angler preference in tournament characteristics (e.g., cost, length, sponsorship, catch-and-release vs landing formats, and other activities corresponding to the event) may increase angler participation and also give insight as to how management of the fishery could be improved. In general, anglers who participate in tournaments typically are more involved in the conservation of the target species and its habitat than those recreational anglers not similarly participating in competitions (Thailing et al. 2001, Oh et al. 2007).

Recreational fishing tournaments are increasingly important venues for gathering information on species. Some of the strongest driving forces to improve management of species are the anglers targeting them (de Sylva 1969). Knowledge gained from tournaments supplements swordfish data gathered from commercial fishers, non-tournament recreational anglers, and fishery independent studies, all of which would require coverage at many venues over a large geographic range.

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